Library Progress International
Vol.44 No. 3, July-December 2024: P. 24393-24404

Print version ISSN 0970 1052
Online version ISSN 2320 317X

Original Article

Available online at www.bpasjournals.com

Leveraging Technology in Construction Supply Chain Management: A Review of Strategies and Future Directions

N.N.Phani Babu[1*], A.Aravindan[2],NadigatlaNaveenKumar[3]

[1*]Department of Civil Engineering, Koneru Lakshmaiah Education Foundation (KL Deemed to be University), Guntur, Vaddeswaram, India. Email: phaninadiminti999@gmail.com
[2]Department of Civil Engineering, Koneru Lakshmaiah Education Foundation (KL Deemed to be University), Guntur, Vaddeswaram, India. Email: aaravindan@kluniversity.in
[3]Department of Civil Engineering, Koneru Lakshmaiah Education Foundation (KL Deemed to be University), Guntur, Vaddeswaram,India.Email: naveencivilengineer3@gmail.com

How to cite this article: N.N.Phani Babu, A.Aravindan,NadigatlaNaveenKumar (2024) Leveraging Technology in Construction Supply Chain Management: A Review of Strategies and Future Directions**.** *Library Progress International***,** 44(3), 24393-24404

Abstract
Supply Chain Management (SCM) plays a pivotal role in the construction industry, influencing project efficiency, cost-effectiveness, and overall quality. This review article examines the key components and strategies of SCM in construction, including procurement, logistics, and collaboration among stakeholders. It highlights the unique challenges faced by the construction sector, such as project complexity, diverse stakeholder involvement, and fluctuating material costs. The study also explores advancements in technology that enhance SCM practices, such as Building Information Modelling (BIM), Artificial Intelligence (AI), and the Internet of Things (IoT). By analyzing existing literature and case studies, this article identifies the benefits of effective SCM, including improved project delivery, reduced waste, and enhanced communication. Additionally, it discusses the limitations and risks associated with SCM in construction, emphasizing the need for a strategic approach to mitigate these challenges. The article concludes with recommendations for future research and practice, underscoring the importance of integrating innovative technologies to streamline supply chain processes and improve construction project outcomes.
Keywords: Supply Chain Management**,** Construction Industry, Logistics, Building Information Modelling, Artificial Intelligence.

1. Introduction

The construction industry is inherently complex, characterized by a multitude of stakeholders, project types, and dynamic environments. Effective Supply Chain Management (SCM) is essential for navigating this complexity, as it involves coordinating various activities, from procurement and logistics to communication and collaboration among all parties involved. SCM in construction is defined as the integration of people, systems, activities, information, and resources in a manner that enhances project efficiency and effectiveness.

Historically, the construction industry has faced numerous challenges related to inefficiencies, delays, and cost overruns. Factors such as fragmented project delivery methods, lack of standardization, and communication barriers have often hindered the successful execution of construction projects. These challenges underscore the need for a robust SCM framework that addresses the unique requirements of the construction sector.

SCM encompasses a wide range of activities, including sourcing materials, managing suppliers, coordinating logistics, and ensuring that the right resources are available at the right time and place. The ultimate goal of SCM is to optimize project performance while minimizing costs and maximizing value. As construction projects become increasingly complex, the importance of SCM continues to grow.

In recent years, the integration of advanced technologies into SCM practices has revolutionized the way construction projects are managed. Tools such as Building Information Modelling (BIM), Artificial Intelligence (AI), and the Internet of Things (IoT) have enabled more efficient planning, execution, and monitoring of construction activities. These technologies facilitate better communication among stakeholders, streamline processes, and enhance decision-making capabilities.

2. Objectives

The primary objectives of this review article are to:

1. Analyze the current state of Supply Chain Management in the construction industry.

2. Identify the key components and strategies for effective SCM.
3. Explore the role of technology in enhancing SCM practices.
4. Examine the benefits, limitations, and risks associated with SCM in construction.
5. Provide recommendations for future research and practice in SCM.

3. Scope

This review focuses on various aspects of SCM within the construction sector, including:

- Procurement processes and supplier management
- Logistics and material handling
- Collaboration and communication among stakeholders
- Technological advancements impacting SCM
- Case studies illustrating best practices and challenges.

4. Literature Review

Supply chain management (SCM) in the construction industry has garnered increasing attention from researchers and practitioners due to its complex nature and critical role in project success. This literature review synthesizes current findings on SCM practices, challenges, and innovations in construction, emphasizing the interplay between supply chain dynamics and project performance.

Overview of Supply Chain Management in Construction

Al-Werikat (2017) highlights the intricacies of SCM in the construction sector, noting the need for effective strategies to navigate its unique challenges. Supply chains in construction often involve multiple stakeholders, including suppliers, contractors, and clients, leading to fragmented information flow and coordination issues. Lovrenčić Butković et al. (2016) provide a comprehensive literature review, revealing that effective SCM is crucial for improving project outcomes, reducing costs, and enhancing collaboration among stakeholders.

Performance Management and Decision Support

Innovative decision support models have been developed to manage construction supply chain performance more effectively. Yildiz and Ahi (2020) propose a decision support model that integrates various performance metrics, enhancing the decision-making process in SCM. Similarly, Pero et al. (2015) emphasize the significance of product modularity in linking supply chain integration with performance in both construction and shipbuilding industries.

Technology and Digitalization in Supply Chains

The advent of Industry 4.0 technologies has transformed SCM practices in construction. Strandhagen et al. (2020) explore how digital tools can address sustainability challenges in shipbuilding supply chains, which may have parallels in construction. The integration of technologies such as RFID has been shown to improve visibility and traceability in engineer-to-order (ETO) supply chains (Pero & Rossi, 2014). Additionally, the role of cloud manufacturing in enhancing collaboration among supply chain partners is discussed by Tedaldi and Miragliotta (2020), suggesting that such technologies can lead to more resilient and efficient supply chains.

Resilience and Sustainability in Supply Chains

In light of global disruptions, such as the COVID-19 pandemic, the importance of resilience in supply chains has become increasingly evident. Shishodia et al. (2020) investigate supplier resilience in project-driven supply chains, highlighting strategies for enhancing resilience amid uncertainties. Liao et al. (2022) conduct a systematic literature review on construction supply chain management, identifying resilience as a key area for future research. Awaad et al. (2024) further contribute to this discourse by examining the impact of material supply chains on productivity optimization in road construction projects, underlining the need for resilient supply chains to mitigate risks.

Green Supply Chain Management

The transition from traditional SCM to green supply chain management (GSCM) is another critical theme in the literature. Saini et al. (2023) investigate the transformation of SCM practices to incorporate sustainability considerations, emphasizing the environmental impact of construction activities. This shift towards GSCM is crucial for addressing environmental challenges and promoting sustainable practices within the construction sector.

Challenges and Future Directions

Despite advancements in SCM, challenges persist, including supply chain fragmentation, lack of standardization, and inadequate integration of technology. Cigolini et al. (2020) and Studer & De Brito Mello (2021) stress the

need for core elements underpinning effective SCM, such as communication, collaboration, and technology adoption. Future research should focus on developing frameworks that integrate technological innovations with traditional SCM practices to enhance performance and resilience.

In summary, the literature reveals that SCM in the construction industry is a dynamic and evolving field. Innovations in technology, resilience strategies, and the shift towards sustainable practices are pivotal for improving supply chain performance. Continued exploration of these themes will provide valuable insights for researchers and practitioners aiming to optimize SCM in construction. Future studies should also consider the implications of external disruptions on supply chain dynamics, ensuring that strategies remain relevant in an ever-changing environment.

5. Current State Of Supply Chain Management (SCM)

The current state of Supply Chain Management (SCM) in the construction industry reflects both challenges and opportunities, shaped by recent trends and developments. Here are some key aspects of the current landscape:

1. Supply Chain Disruptions

- **Pandemic Impact**: The COVID-19 pandemic exposed vulnerabilities in supply chains, causing material shortages, project delays, and increased costs. Many construction firms faced challenges in sourcing materials and managing labour shortages.

- **Geopolitical Factors**: Ongoing geopolitical tensions and trade disputes have further complicated supply chains, affecting the availability and cost of materials, especially those sourced internationally.

2. Material Shortages and Price Volatility

- **Increased Costs**: The construction industry has seen significant price increases for essential materials like steel, lumber, and concrete. This has prompted firms to re-evaluate their sourcing strategies and inventory management.

- **Sourcing Challenges**: Difficulty in obtaining materials has led to delays and project overruns, forcing contractors to explore alternative suppliers and local sourcing options.

3. Technological Adoption

- **Digital Transformation**: Many construction firms are embracing technology to enhance SCM practices. This includes the use of Building Information Modelling (BIM), project management software, and supply chain visibility tools.

- **IoT and Automation**: The integration of IoT devices for tracking materials and equipment, along with automation in procurement processes, is becoming more prevalent, improving efficiency and transparency.

4. Sustainability and Environmental Concerns

- **Green Building Practices**: There is a growing emphasis on sustainable construction materials and practices, driven by regulatory requirements and consumer demand. This shift impacts sourcing decisions and supply chain strategies.

- **Circular Economy**: Some firms are adopting circular economy principles, focusing on reusing and recycling materials, which influences supply chain management and procurement strategies.

5. Collaboration and Partnerships

- **Integrated Supply Chains**: Increasingly, construction companies are collaborating with suppliers, subcontractors, and other stakeholders to create integrated supply chains. This collaboration is essential for improving efficiency and reducing risks.

- **Strategic Alliances**: Forming strategic partnerships helps firms gain access to better pricing, innovation, and new technologies.

6. Labor Shortages and Skill Gaps

- **Workforce Challenges**: The construction industry faces a significant labour shortage, which impacts supply chain efficiency. The lack of skilled workers can lead to project delays and inefficiencies in execution.

- **Training and Development**: Companies are investing in workforce training and development programs to address skill gaps and enhance productivity.

7. Regulatory Compliance and Risk Management

- **Compliance Requirements**: Construction companies must navigate a complex landscape of regulations, including safety standards and environmental regulations. Effective SCM is essential for ensuring compliance and managing associated risks.

- **Risk Mitigation**: Firms are increasingly focusing on risk management strategies within their supply chains, including diversifying suppliers and creating contingency plans to manage disruptions.

8. Data-Driven Decision Making

- **Analytics and Reporting**: The use of data analytics is growing in importance for SCM in construction. Companies are leveraging data to gain insights into supply chain performance, optimize procurement processes, and forecast demand more accurately.

- **Real-Time Monitoring**: Technologies that provide real-time visibility into supply chain operations are becoming critical for managing performance and addressing issues proactively.

6. Key Components of Effective SCM:

Effective Supply Chain Management (SCM) is crucial for enhancing operational efficiency, reducing costs, and improving customer satisfaction. Here are the key components and strategies for effective SCM

1. **Planning**:
    - Demand forecasting to understand customer needs.
    - Inventory management to optimize stock levels.
    - Capacity planning to ensure the right resources are in place.
2. **Sourcing**:
    - Selecting suppliers based on quality, reliability, and cost.
    - Building strong relationships with suppliers for better collaboration.
    - Establishing contracts and terms of service that align with business goals.
3. **Production**:
    - Streamlining production processes to minimize waste.
    - Implementing Just-in-Time (JIT) manufacturing to reduce inventory costs.
    - Utilizing technology and automation to improve efficiency.
4. **Logistics**:
    - Efficient transportation management to optimize delivery times and costs.
    - Warehouse management systems to track inventory and manage storage.
    - Last-mile delivery strategies to enhance customer satisfaction.
5. **Information Flow**:
    - Implementing technology solutions for real-time data sharing.
    - Using Enterprise Resource Planning (ERP) systems to integrate various functions.
    - Ensuring visibility across the supply chain for better decision-making.

6. **Returns Management**:
    - Developing processes for handling returns effectively.
    - Analyzing return data to identify trends and improve products/services.
    - Implementing reverse logistics strategies to recover value from returned goods.

Strategies for Effective SCM

1. **Collaboration**:
    - Foster collaboration between suppliers, manufacturers, and distributors.
    - Utilize shared platforms for information exchange and joint planning.
    - Engage in strategic partnerships to enhance capabilities.
2. **Technology Adoption**:
    - Leverage advanced technologies like AI, IoT, and blockchain for better visibility and efficiency.
    - Implement data analytics to improve forecasting and decision-making.
    - Use automation to streamline operations and reduce human error.
3. **Agility and Flexibility**:
    - Develop agile supply chain practices to respond quickly to changes in demand.
    - Create contingency plans to manage disruptions effectively.
    - Focus on flexibility in sourcing and production processes.
4. **Sustainability**:
    - Integrate sustainable practices into sourcing, production, and logistics.
    - Monitor and reduce the environmental impact of supply chain activities.
    - Engage with suppliers who prioritize sustainability.
5. **Risk Management**:
    - Identify potential risks in the supply chain, such as supplier failure or geopolitical issues.
    - Develop risk mitigation strategies, including diversification of suppliers and inventory buffers.
    - Continuously monitor and assess risks to adapt strategies as needed.
6. **Performance Measurement**:
    - Establish key performance indicators (KPIs) to measure supply chain effectiveness.
    - Regularly review performance against benchmarks and goals.
    - Use insights gained from performance measurement to drive continuous improvement.

By focusing on these components and strategies, organizations can create a robust supply chain that meets the demands of the market while maximizing efficiency and minimizing costs.

7. The Role Of Technology In Enhancing SCM Practices

Technology plays a pivotal role in enhancing Supply Chain Management (SCM) practices by improving efficiency, visibility, and responsiveness throughout the supply chain. Here are several key areas where

technology is transforming SCM:

1. Data Analytics and Forecasting

- **Predictive Analytics**: Advanced algorithms analyze historical data to forecast demand trends, allowing companies to optimize inventory levels and production schedules.
- **Real-time Data Analysis**: Technologies enable companies to monitor and analyze data in real time, helping them make informed decisions quickly.

2. Automation

- **Robotic Process Automation (RPA)**: Automates repetitive tasks in procurement, order processing, and inventory management, reducing errors and freeing up human resources for more strategic activities.
- **Automated Warehousing**: Use of automated systems for picking, packing, and sorting goods improves operational efficiency and reduces labour costs.

3. Internet of Things (IoT)

- **Connected Devices**: IoT devices collect data from various points in the supply chain, such as temperature and humidity levels for sensitive goods, enhancing monitoring and compliance.
- **Asset Tracking**: GPS and RFID technologies enable real-time tracking of shipments and inventory, improving visibility and reducing losses.

4. Blockchain Technology

- **Transparency**: Blockchain provides a decentralized and immutable ledger for tracking goods throughout the supply chain, increasing transparency and trust among stakeholders.
- **Smart Contracts**: Automate and enforce agreements between parties in the supply chain, reducing the need for intermediaries and improving efficiency.

5. Cloud Computing

- **Scalability and Flexibility**: Cloud-based SCM solutions offer scalability, allowing organizations to adapt quickly to changes in demand without significant infrastructure investment.
- **Collaboration**: Cloud platforms facilitate real-time collaboration among supply chain partners, enhancing communication and coordination.

6. Artificial Intelligence (AI) and Machine Learning

- **Enhanced Decision-Making**: AI-driven tools analyze vast amounts of data to provide insights for better decision-making in areas like demand planning, inventory management, and logistics optimization.
- **Chatbots and Virtual Assistants**: AI-powered chatbots streamline customer service and order management processes, improving response times and customer satisfaction.

7. Mobile Technology

- **Mobile Applications**: Enable real-time access to supply chain data and communication tools, allowing stakeholders to make decisions on the go.
- **Field Data Collection**: Mobile devices facilitate data collection from the field, improving accuracy and speed in reporting.

8. Supply Chain Visibility Solutions

- **Dashboard and Visualization Tools**: Provide comprehensive views of the supply chain, allowing managers to monitor performance metrics, identify bottlenecks, and enhance operational efficiency.
- **End-to-End Visibility**: Technologies that offer visibility across the entire supply chain, from suppliers to customers, improve coordination and reduce lead times.

9. E-Commerce Integration

- **Omni-channel Solutions**: Integrate e-commerce platforms with SCM systems to streamline order processing, inventory management, and fulfilment.
- **Customer-Centric Supply Chains**: Technologies enable companies to better respond to customer preferences and demand fluctuations, enhancing customer satisfaction.

8. Benefits of Effective SCM in Construction

1. **Improved Project Delivery**: Effective SCM enables better scheduling and resource allocation, resulting in timely project completion.
2. **Cost Reduction**: By optimizing procurement and logistics processes, SCM can lead to significant cost savings.
3. **Enhanced Communication**: SCM fosters collaboration among stakeholders, improving information flow and reducing misunderstandings.
4. **Increased Quality**: Effective SCM ensures that materials and services meet required standards, enhancing overall project quality.
5. **Waste Minimization**: By optimizing resource use and logistics, SCM can help reduce material waste, contributing to sustainability.

9. Limitations of SCM in Construction

1. **Fragmentation**: The construction industry often involves multiple stakeholders with varying interests, making coordination challenging.
2. **Market Volatility**: Fluctuating material prices and supply chain disruptions can negatively impact project costs and timelines.
3. **Technological Barriers**: Not all construction firms have the resources or expertise to adopt advanced SCM technologies.
4. **Resistance to Change**: Traditional practices and reluctance to embrace new technologies can hinder SCM improvements.
5. **Data Privacy Concerns**: Sharing sensitive information among stakeholders raises concerns about data security and privacy.

10. Advantages of Technological Integration in SCM

1. **Real-time Data Access**: Technologies like IoT provide real-time information on material availability and project progress, enhancing decision-making.
2. **Enhanced Collaboration**: BIM allows stakeholders to visualize projects, improving collaboration and reducing errors.
3. **Predictive Analytics**: AI can analyze historical data to predict potential risks and optimize supply chain processes.
4. **Automation**: Automation of procurement and logistics processes can reduce manual errors and improve efficiency.
5. **Sustainability**: Technology can help monitor environmental impacts, facilitating more sustainable SCM practices.

11. Risks Associated With SCM In Construction.

Supply Chain Management (SCM) in the construction industry involves various risks that can significantly impact project outcomes, timelines, and costs. Here are some of the key risks associated with SCM in construction:

1. Material Shortages

- **Availability Risks**: Fluctuations in material availability can lead to delays and increased costs, especially for critical components like steel, concrete, and specialized equipment.
- **Supply Chain Disruptions**: Events such as natural disasters, geopolitical tensions, or pandemics can disrupt the supply of materials, causing project delays.

2. Price Volatility

- **Cost Escalation**: Rapid increases in material prices can lead to budget overruns and financial strain on projects. This volatility can be driven by market demand, inflation, or changes in trade policies.
- **Contractual Risks**: Fixed-price contracts may expose contractors to losses if material prices rise significantly during the project lifecycle.

3. Supplier Reliability

- **Quality Issues**: Inconsistent quality from suppliers can lead to rework, project delays, and increased costs. Poor-quality materials can also compromise safety and structural integrity.
- **Supplier Financial Stability**: The financial health of suppliers is critical; bankruptcies or financial troubles can disrupt the supply chain and lead to delays.

4. Labor Shortages

- **Skilled Labor Gaps**: A shortage of skilled labour can lead to inefficiencies in project execution and difficulties in maintaining schedules. This is exacerbated by an aging workforce and a lack of new talent entering the industry.
- **Labor Disputes**: Strikes or labour disputes can halt construction projects, impacting timelines and costs.

5. Logistics Challenges

- **Transportation Delays**: Inefficient logistics management can lead to delays in material delivery, affecting project schedules. Traffic congestion, road conditions, and transportation costs can also be significant factors.
- **Last-Mile Delivery Issues**: Ensuring materials reach the construction site on time can be challenging, especially in urban areas or remote locations.

6. Regulatory and Compliance Risks

- **Changing Regulations**: The construction industry is subject to numerous regulations. Changes in safety, environmental, and building codes can impact supply chain operations and require adjustments to materials or processes.
- **Compliance Costs**: Failure to comply with regulations can result in fines, project delays, or legal issues, adding to overall project risk.

7. Technological Risks

- **Cybersecurity Threats**: Increased reliance on technology and digital systems exposes construction firms to cybersecurity threats, which can compromise sensitive data and disrupt operations.
- **System Failures**: Technical failures or software issues in supply chain management systems can hinder operations and lead to delays.

8. Project Complexity

- **Interdependencies**: Large construction projects often involve multiple subcontractors and suppliers, creating complex interdependencies that can complicate SCM and increase the risk of delays.
- **Change Orders**: Frequent changes in project scope can disrupt supply chain planning and lead to inefficiencies and increased costs.

9. Risk of Natural Disasters

- **Weather Impacts**: Natural disasters such as hurricanes, floods, or earthquakes can halt construction activities, damage materials, and disrupt the supply chain.
- **Environmental Factors**: Adverse weather conditions can impact transportation logistics and the ability to deliver materials on time.

10. Financial Risks

- **Cash Flow Issues**: Delays in receiving payments from clients can strain cash flow, affecting the ability to pay suppliers and subcontractors, leading to potential supply chain disruptions.
- **Budget Overruns**: Inaccurate budgeting or unforeseen costs can impact project viability and supplier relationships.

12. Challenges in Supply Chain Management in Construction

1. **Complexity of Projects**:
    - Construction projects often involve multiple stakeholders, including contractors, subcontractors, suppliers, and clients, making coordination and communication challenging.
    - The intricate nature of construction processes and timelines can lead to misunderstandings and inefficiencies.
2. **Diverse Stakeholder Involvement**:
    - Each stakeholder has different objectives, priorities, and levels of experience, complicating collaboration.
    - Conflicting interests can lead to delays and increased costs.
3. **Fluctuating Material Costs**:
    - Volatility in material prices can impact budgeting and project feasibility.
    - Supply chain disruptions, such as those caused by natural disasters or geopolitical events, can exacerbate these fluctuations.
4. **Limited Integration of Technology**:
    - Despite advancements in technology, many construction firms are slow to adopt tools like Building Information Modelling (BIM), Artificial Intelligence (AI), and the Internet of Things (IoT).
    - Insufficient training and knowledge can hinder effective technology implementation.
5. **Risk Management**:
    - Identifying and mitigating risks associated with supply chain disruptions is critical but often overlooked.
    - Lack of proactive risk management strategies can lead to project delays and cost overruns.
6. **Regulatory Compliance**:
    - Navigating regulatory requirements can complicate procurement and logistics, particularly in regions with stringent construction regulations.
    - Ensuring compliance with local, national, and international standards can be resource-intensive.
7. **Environmental Sustainability**:
    - Increasing pressure to adopt sustainable practices can complicate supply chain decisions.

- Balancing cost-effectiveness with environmentally responsible sourcing and practices is a growing challenge.

13. Future Directions for Supply Chain Management in Construction

1. **Embracing Digital Transformation**:
   - Increased adoption of digital tools such as BIM, AI, and IoT can enhance collaboration, improve decision-making, and streamline processes.
   - Utilizing data analytics can help firms forecast demand, manage inventory, and optimize logistics.
2. **Enhanced Collaboration Platforms**:
   - Developing integrated platforms that facilitate real-time communication and collaboration among stakeholders can address coordination challenges.
   - Implementing cloud-based solutions can enable better visibility into project progress and supply chain dynamics.
3. **Sustainability and Circular Economy**:
   - Future SCM practices should focus on sustainability, promoting the use of recycled materials and sustainable sourcing practices.
   - Implementing circular economy principles can reduce waste and enhance resource efficiency.
4. **Agile Supply Chain Models**:
   - Transitioning to more agile supply chain models can help construction firms respond quickly to changing project requirements and market conditions.
   - Flexibility in sourcing and logistics can minimize disruptions and enhance project resilience.
5. **Advanced Risk Management Techniques**:
   - Investing in risk assessment tools and methodologies can improve the identification and mitigation of potential supply chain risks.
   - Scenario planning and contingency strategies can enhance preparedness for unexpected disruptions.
6. **Collaboration with Technology Providers**:
   - Partnering with technology providers can accelerate the adoption of innovative tools and practices.
   - Training programs and workshops can help stakeholders understand and leverage new technologies effectively.
7. **Research and Development**:
   - Encouraging research into new SCM strategies and technologies can drive continuous improvement in the construction sector.
   - Collaboration between academia and industry can foster innovation and address emerging challenges.

14. Discussion

The construction industry has witnessed significant advancements in SCM practices, driven by technological innovations and a growing awareness of the importance of efficient supply chain processes. However, challenges remain, particularly in addressing the fragmentation and complexity of the construction environment. Successful

SCM requires a holistic approach that considers the interdependencies among various stakeholders and integrates innovative technologies to streamline processes.

Collaboration is crucial in overcoming the limitations of SCM. Stakeholders must work together to establish standardized practices, share information, and align their interests. Furthermore, the construction industry must embrace a culture of innovation, encouraging the adoption of new technologies that enhance SCM practices.

15. Conclusion

Supply Chain Management is a critical factor in the success of construction projects. By optimizing procurement, logistics, and collaboration, SCM can lead to improved project outcomes, cost savings, and enhanced quality. Despite the challenges inherent in the construction industry, the integration of advanced technologies presents a significant opportunity to revolutionize SCM practices. Future research should focus on exploring innovative solutions to address the unique needs of the construction sector, fostering a more efficient and sustainable supply chain. As the industry continues to evolve, embracing these changes will be essential for staying competitive and achieving project success.

16. References

1. Al-Werikat, Ghaith. (2017). Supply Chain Management In Construction; Revealed. International Journal of Scientific & Technology Research. 6. 106-110.
2. Lovrenčić Butković, Lana & Grilec, Alica & Mikulic, Josip. (2016). Supply Chain Management in the Construction Industry – A Literature Review.
3. Yildiz, K., and M. T. Ahi. 2020. “Innovative Decision Support Model for Construction Supply Chain Performance Management.” *Production Planning and Control* (forthcoming).
4. Tedaldi, G., and G. Miragliotta. 2020. “The Role of Engineering-to-Order Machinery Manufacturers in Future Cloud Manufacturing Supply Chains: A Business Case and a Strategic Perspective.” *Production Planning and Control* (forthcoming).
5. Strandhagen, J., S. V. Buer, M. Semini, E. Alfnes, and J. Strandhagen. 2020. “Sustainability Challenges and How Industry 4.0 Technologies Can Address Them: A Case Study of a Shipbuilding Supply Chain.” *Production Planning and Control* (forthcoming).
6. Shishodia, A., P. Verma, and K. Jain. 2020. “Supplier Resilience Assessment in Project-Driven Supply Chains.” *Production Planning and Control* (forthcoming).
7. Pero, M., M. Stößlein, and R. Cigolini. 2015. “Linking Product Modularity to Supply Chain Integration in the Construction and Shipbuilding Industries.” *International Journal of Production Economics*170: 602–615.
8. Pero, M., and T. Rossi. 2014. “RFID Technology for Increasing Visibility in ETO Supply Chains: A Case Study.” *Production Planning and Control*25 (11): 892–901.
9. Gosling, J., D. R. Towill, M. M. Naim, and A. R. Dainty. 2015. “Principles for the Design and Operation of Engineer-to-Order Supply Chains in the Construction Sector.” *Production Planning and Control* 26 (3): 203–218.
10. Ekeskär, A., and M. Rudberg. 2020. “Third-Party Logistics in Construction: Perspectives from Suppliers and Transport Service Providers.” *Production Planning and Control* (forthcoming).
11. Braglia, M., P. Dallasega, and L. Marrazzini. 2020. “Overall Construction Productivity: A New Lean Metric to Identify Construction Losses and Analyze Their Causes in Engineer-to-Order Construction Supply Chains.” *Production Planning and Control* (forthcoming).
12. Cigolini, R., Gosling, J., Iyer, A., & Senicheva, O. (2020). Supply chain management in construction and engineer-to-order industries. *Production Planning & Control*, *33*(9–10), 803–810.
13. Liao, L., Yang, C., & Quan, L. (2022). Construction supply chain management: A systematic literature review and future development. *Journal of Cleaner Production*, *382*, 135230. https://doi.org/10.1016/j.jclepro.2022.135230
14. Studer, W., & De Brito Mello, L. (2021). Core elements Underlying supply chain management in the Construction Industry: A Systematic Literature review. *Buildings*, *11*(12), 569. https://doi.org/10.3390/buildings11120569
15. Chen, Z., Hammad, A. W., & Alyami, M. (2023). Building construction supply chain resilience under supply and demand uncertainties. *Automation in Construction*, *158*, 105190. https://doi.org/10.1016/j.autcon.2023.105190
16. Awaad, S., Mansour, D. M., Mahdi, I., & Abdelrasheed, I. (2024). Impact of material supply chain on the productivity optimization for the construction of roads projects. *Scientific Reports*, *14*(1). https://doi.org/10.1038/s41598-024-53660-6

17. Abidenn, A., Sorooshian, S., Sundram, V. & Mohammed, A. Collaborative insights on horizontal logistics to integrate supply chain planning and transportation logistics planning—A systematic review and thematic mapping. *J. Open Innov. Technol. Mark. Complex.* **9**(2), 100066 (2023).
18. Cai, J., Liu, X., Xiao, Z. & Liu, J. Improving supply chain performance management: A systematic approach to analyzing iterative KPI accomplishment. *Decis. Support Syst.* **46**(2), 512–521 (2009).
19. Kaushik, S. Material supply chain practices in the construction industry. *Int. Res. J. Eng. Technol.* **5**(7), 543–554 (2018).
20. Saini, N., Malik, K. & Sharma, S. Transformation of supply chain management to green supply chain management: Certain investigations for research and applications. *Clean. Mater.* **7**, 100172 (2023).